

Article	Population	Pain Setting	Pain Scale (Ground ML Classifiers)	Output	Results	Accuracy (DOP)	Accuracy (PI)	Average Accuracy	Average Accuracy
<a href="#">Artificial intelligence to evaluate postoperative pain based on facial expression recognition - Feature - 2022</a>	Adult patients from a single university hospital	Postoperative pain	Numerical Rating Scale (NRS)	Convolutional Neural Network (CNN)	Pain Intensity estimation Pain Intensity - Accuracy = 53% Detection of Pain - Accuracy = 89%	89.00%	53.00%	85.05%	73.90%
<a href="#">Deep Pain: Exploiting Long Short-Term Memory Networks for Facial Expression Classification</a>	UNBC-McMaster database	Self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Convolutional Neural Network - Long short-term memory (CNN - LSTM)	Pain Detection and Pain Intensity Pain Detection - Accuracy = 83% - AUC = 93.3% Pain Intensity Estimation - MSE = 0.74	83.00%	26.00%	DOP = Detection of Pain	PI = Pain Intensity
<a href="#">Automatic Decoding of Facial Movements Reveals Deceptive Pain Expressions</a>	Healthy Subjects	Cold pressor-induced pain	Pain stimuli-dependent assessments	Support Vector Machine (SVM)	Detection of genuine vs. faked pain AUC = 0.91 Accuracy = 85%	85.00%	N/A		
<a href="#">Automatic, Human Recognition of Pain Intensity from Facial Expression on the X-ITE Pain Database</a>	X-ITE Pain Database	Heat-induced and electrical-induced pain	NRS categorized into 4 pain intensities (no pain, low, medium, and severe)	2-CNN's with sample weighting (complementing each other)	Pain Intensity estimation with two groupings of pain levels (none/low/ever e. 8 none/moderate/severe)	Accuracy = 51.7%	N/A	51.70%	
<a href="#">Ensemble neural network approach detecting pain intensity from facial expressions - ScienceDirect</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Convolutional Neural Network - Recurrent neural network (CNN - RNN)	Pain Intensity estimation UNBC-McMaster - Accuracy = 86% - AUC = 90.5%	N/A	86.00%		
<a href="#">Ensemble neural network approach detecting pain intensity from facial expressions - ScienceDirect</a>	MintPAIN database	electrical-induced pain	Stimuli-based pain levels (0-4)	Convolutional Neural Network - Recurrent neural network (CNN - RNN)	Pain Intensity estimation MintPAIN - Accuracy = 92.26% - AUC = 93.67%	N/A	92.26%		
<a href="#">A novel approach for pain intensity detection based on facial feature deformations - ScienceDirect</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Double Machine Learning (DML) combined with Support Vector Machine (SVM)	Pain Intensity estimation (PSPI) Accuracy = 96%	N/A	96.00%		
<a href="#">Automatically Detecting Pain in Video Through Facial Action Units   IEEE Journals &amp; Magazines</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Support Vector Machine (SVM)	Pain detection Accuracy = 80.9% AUC = 84.7%	80.90%	N/A		
<a href="#">Enhanced deep learning algorithm development to detect pain intensity from facial expression images - ScienceDirect</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Hybrid Convolutional Neural Network (CNN) - bidirectional Long Short-term Memory (LSTM)	Pain Intensity Estimation, categorized into four levels (PSPI 0, 1, 2, 3, greater than 4) Accuracy = 85% AUC = 88.7% MSE = 0.21 MAE = 0.18 F-measure = 78.2%	85.00%	79.00%		
<a href="#">Automatic coding of facial expressions displayed during posed and genuine pain - ScienceDirect</a>	University students	Cold pressor-induced pain	Pain stimuli-dependent assessments	Gaussian Support Vector Machine (SVM)	genuine vs. faked pain Accuracy = 88%	88.00%	N/A		
<a href="#">Automated detection of pain levels using deep feature extraction from shutter-blade-based dynamic-based horizontal patches with facial images   Scientific Reports</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	K-Nearest Neighbor	Pain Intensity Estimation, categorized into four levels (PSPI 0, 1, 2, 3, greater than 4) Accuracy = 95.57% Average F1 = 95.67% (The F1 score is calculated as the harmonic mean of the precision and recall scores)		95.57%		
<a href="#">The modeling of human facial pain intensity based on Temporal Convolutional Networks trained with video frames in HSV color space</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Temporal Convolutional Network (TCN)	Pain Intensity Estimation, categorized into four levels (PSPI 0, 1, 2, 3, greater than 4) Accuracy = 94.14% AUC = 91.3% MSE = 0.186 MAE = 0.234	94.14%	81.40%		
<a href="#">The modeling of human facial pain intensity based on Temporal Convolutional Networks trained with video frames in HSV color space</a>	MintPAIN database	electrical-induced pain	Stimuli-based pain levels (0-4)	Temporal Convolutional Network (TCN)	Pain Intensity Estimation, categorized into five levels (0-4) Accuracy = 89% AUC = 92% MSE = 0.22 MAE = 0.26	89.00%	78.00%		
<a href="#">Multiview Distance Metric Learning on Facial Feature Descriptors for Automatic Pain Intensity Detection - ScienceDirect</a>	UNBC-McMaster database	self-identified shoulder pain	Prkachin and Solomon Pain Intensity (PSPI)	Support Vector Machine (SVM)	Pain detection Accuracy = 89.59% Pain Intensity estimation Accuracy = 75%	89.59%	75.00%		

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<a href="#">Metrological Characterization of a Pain Detection System Based on Transfer Entropy of Facial Landmarks   IEEE Journals &amp; Magazine</a>	UNBC-McMaster database	self-identified shoulder pain	Visual Analog Scale	Linear discriminant analysis	Pain detection (VASd) Pain intensity (VAS) estimation	Pain detection AUC = 0.87 Pain intensity estimation MAE = 2.44	85.00%	97.56%	
<a href="#">Self-supervised pain intensity estimation from facial videos via statistical spatiotemporal distillation - ScienceDirect</a>	UNBC-McMaster database	self-identified shoulder pain	Phkacin and Solomon Pain Intensity (PSPI)	Convolutional Neural Networks (CNNs)	Estimation of pain intensity UNBC-McMaster: 16 pain levels	Training with BioVid and testing on UNBC-McMaster Self-supervised model: AUC = 0.692 Supervised model: AUC = 0.801		75.00%	
<a href="#">Self-supervised pain intensity estimation from facial videos via statistical spatiotemporal distillation - ScienceDirect</a>	BioVid database (part A)	heat-induced pain	stimuli-based pain (5 levels)	Convolutional Neural Networks (CNNs)	Estimation of pain intensity BioVid: 5 pain levels	Training with UNBC-McMaster and testing on BioVid [Self-supervised] model: AUC = 0.655 [Supervised] model: AUC = 0.755		75.00%	
<a href="#">Automated Assessment of Children's Postoperative Pain Using Computer Vision   Pediatrics</a>	Pediatric patients from a tertiary care center	postoperative pain	Numerical Rating Scale (NRS)	Logistic regression and linear regression models	Pain Detection (NRS ≥ 4) Pain intensity estimation (NRS)	Pain Detection Baseline pain: AUC = 0.84 Pain intensity estimation Baseline pain: $r = 0.47$ ; $p = 4.4 *$	85.00%	47.00%	
<a href="#">Deep Learning for Identification of Acute Illness and Facial Cues of Illness</a>	volunteers	states of acute illness (fake)	use of lipopolysaccharide (LPS) which triggers an immune response resembling acute illness	Neural transfer convolutional Neural Network (NT-CNN) and four Convolutional Neural Networks (CNN)	Pain detection	Pain Detection AUC = 0.67	67.00%	N/A	